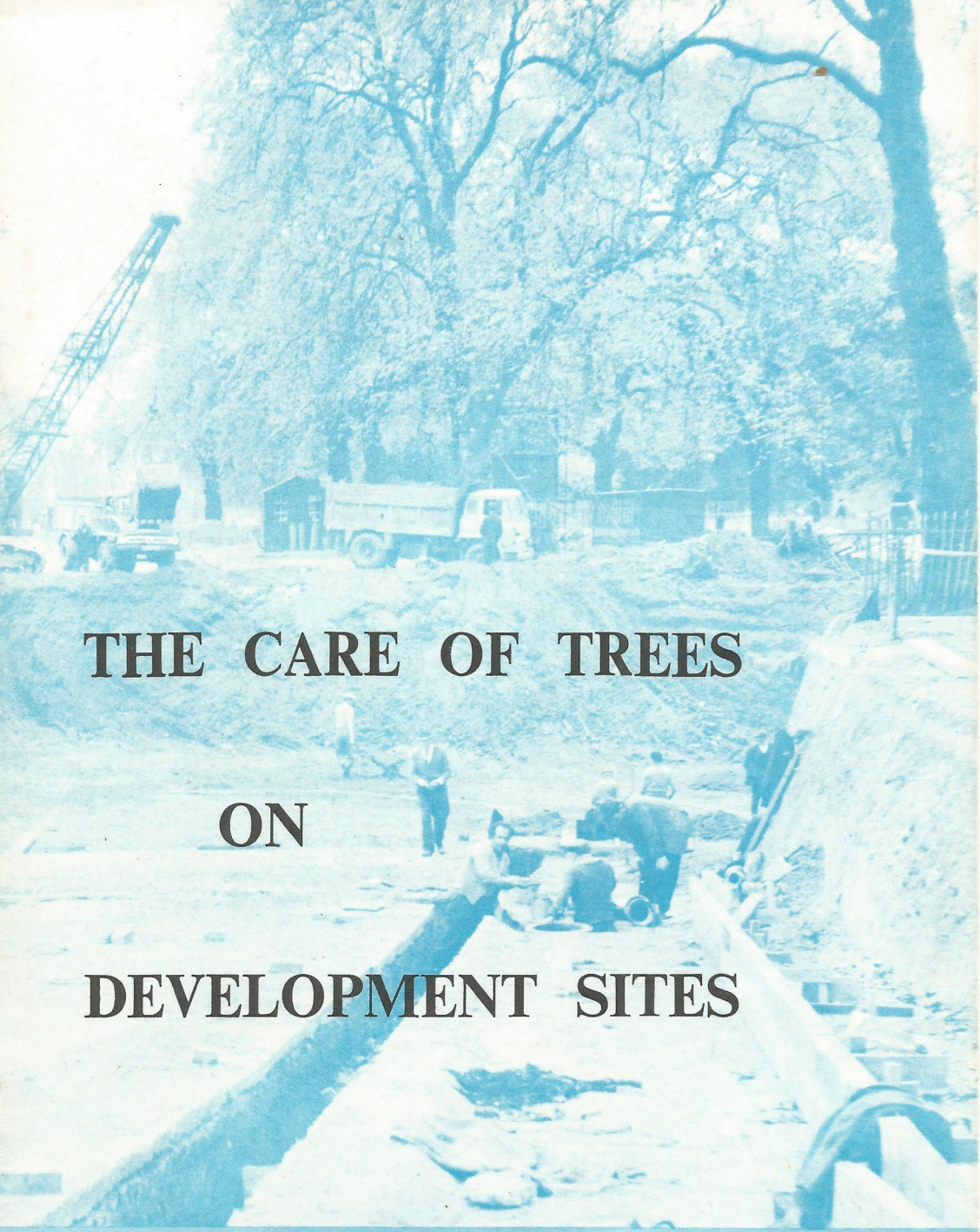

THE CARE OF TREES ON DEVELOPMENT SITES

ARBORICULTURAL ASSOCIATION ADVISORY LEAFLET No. 3

"The Care of Trees on Development Sites"
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Cover photograph, taken by Bertram W. Chapman, of the construction of Hyde Park underground car park by Sir Robert McAlpine and Sons Ltd., by courtesy of Westminster City Council.

The Care of Trees on Development Sites

A. INTRODUCTORY

In spite of determined efforts by Local Authorities to preserve trees by means of Tree Preservation Orders and Planning Conditions, and in spite of equally strong intentions on the part of Architects, Landscape Architects, Civil Engineers, Building Contractors and the Developers themselves, there have been cases in the past where trees have not survived. They have died or been blown over either during building operations or within a few years of the completion of the development.

Sometimes their death is due to inadequate forethought or site supervision, but it is more often due to unawareness of the effects of soil compaction, of alteration in water table levels, interference with drainage, opening up to the wind or of a number of other factors, or of the cumulative effect of two or more of them.

The object of this leaflet is to examine these factors in detail so that the necessary practical steps can be taken during the design stage before work begins, and a number of precautions observed during the course of construction.

The leaflet is divided into four sections. The first under the title of " Surveys " deals with the collection of information about the site and its trees. The second, " Design ", covers various factors which will influence the design and layout of the buildings. The third deals with some of the working problems likely to be encountered in the erection of buildings, and the fourth contains general recommendations.

B. SURVEYS

1. *Site Survey*

The basic site survey generally consists of a ground plan with the boundaries and levels marked on it. The positions of trees are shown, and sometimes their types and their bole diameters, and less frequently the extent of their tree canopies.

This survey should be supplemented with two additional ones—an Ecological Survey, detailing the growing conditions in and around the site, and a Tree Survey, giving details of each tree, its physical condition, its visual importance and any useful function it may serve, such as screening unsightly objects.

2. *Ecological Survey*

Ecological surveys will be needed more in rural areas; in built-up areas not all the factors below will apply. The ecological survey should cover the following aspects: —

(a) *Soil Type*—gravel, sand, loam, heavy clay, peat, etc. The type of soil is an important factor when dealing with problems of drainage or soil compaction.

(b) *Prevailing Wind.* This can often be seen from the way in which trees have been cut by the wind, and is an important factor in deciding which trees can be removed from groups or clumps.

(c) *Altitude of Site.*
(d) *Exposure.*
(e) *Annual Rainfall.*
(f) *Annual Sunshine.*

These four, together with soil type, have a bearing on the ultimate height and spread of the trees on the site.

(g) *Land Form.* Its drainage, whether natural or artificial, will be affected both by the erection of buildings and by the building operations themselves, and in turn may affect whatever is growing in the area.

3. *Tree Survey*

The Tree Survey should provide the following information: —

(a) *Type and Age.* The designer will want to know the type and age of each tree, and both factors, together with its physical condition, will have a bearing on the possible future life span.

(b) *Canopy Spread.* The present canopy spread, taken in conjunction with the age of the tree, will give some idea of the future spread when fully developed.

(c) *Physical Condition.* A record of the condition of each tree will be needed before deciding which trees should be removed or retained, and physical condition can be divided into four categories: —

A Sound and healthy.

B Defective, but the defect can be rectified and the tree should reach maturity.

C Defective; the defect cannot be rectified but the tree still has a limited useful life.

D Defective to the point of being dangerous.

Some authorities use three categories denoted by the three colours Green, Amber and Red; in this case, groups B and C above are combined to form the Amber category.

(d) *Amenity Value.* Some trees because of their age, shape or their position have an unexpectedly high environmental value and this factor should be recorded in the survey : —

(i) Tree of unusually fine shape, size, age, rarity or in an important position.

(ii) Tree of interesting or " picturesque " habit, which might be faulted from an arboricultural or physical condition standpoint, but which makes an important contribution to the environment.

(iii) An ordinary tree of no particular distinction.

(iv) Deformed tree—deformation caused by being drawn up, overshadowed or topped. Immediate planting of a replacement should be considered.

(e) *Groups of trees or Woods.* Where numbers of trees are growing close together, it is sometimes impracticable to survey each tree separately, and general notes about the condition of the woodland, the need for thinning, etc., are of more value.

(f) *Other Factors.* There may be a number of other factors governing the retention of trees, such as retention for a limited period, for shelter as windbreaks or as nurses to new planting, or as temporary screening until new planting takes over.

(g) *Restrictions on lopping, topping or felling of trees.* The existence of any Tree Preservation Order or Restrictive Covenant should be recorded.

C. DESIGN

All the items listed in the Ecological Survey together with the additional ones of animal, bird and insect life form the ecological balance of the area. If the balance is relatively stable, the area is unlikely to change, but alteration of one or more factors, or the introduction of one or more new ones, will upset the equilibrium and changes will occur. Some such changes can be so decisive as to make the growing conditions for established trees intolerable and death will follow.

Excavation on a site and the erection of a building can alter the existing drainage system; roofs on new buildings and the provision of hard surfaces for car parking, together with the collection of rain water from them into stormwater sewers, can affect the moisture content in the soil and lower the level of the water table. These are two examples of changes which can be decisive enough to kill existing trees. They and others are dealt with more fully below.

1. *Interference with existing drainage.* When it rains, water is passed into the soil and a great part of it is absorbed by the soil particles themselves. Some of the surplus water finds its way horizontally through water courses and streams into the rivers, though in the case of clays, there is a tendency for the water to remain on the surface and cause flooding. If the contours are such that the water cannot run off, or natural drainage channels become blocked, bogs and marshes form. Farmers and others use an artificial system of drains and ditches to accelerate the disposal of surplus water.

   Excavations, the movement of machinery, the grubbing up of tree-roots, the compaction of soil, the erection of the building and the making of roads will disturb the natural or artificial drainage, and in low-lying areas or in heavy soils or with certain land formations, the effects can be serious.

   If building operations are likely to continue over one or more years, it may be necessary to form a temporary drainage system until the original can be restored, or a new one created.

2. *Alterations of water table level.* The remainder of the surplus water from the rain passes vertically downwards through fissures and cracks. Below a certain level, never very far down in this country, the soil and porous or fissured rock is saturated with water.

   The level of this water roughly follows the relief of the ground, but varies upwards and downwards with the dryness or wetness of summers and winters.

   The introduction of large areas of hard surfaces in the form of drained roads, pavements, car parking areas, garage forecourts, buildings, terraces and even swimming pools and concrete-bottomed lakes and ponds, reduces the amount of water passing into the soil and lowers the general level.

   There have been occasions when large mature oaks have been retained in housing layouts as focal points, but a few years after the development was complete the trees became stag-headed and died. The cause was the comparatively sudden lowering of the water table below the level to which the trees had become accustomed.

Under certain conditions and in certain soils, it may be possible to maintain the existing water level by leading some of the roof rain water to soakaways near the tree root system, and by using soakaways, instead of drains, for disposal of storm water from roads over a large area around the trees.

3. *Alterations in site levels.* Research has shown that 95 per cent of tree and shrub roots are to be found in the top 4 feet of the soil—that is, in the layer with maximum organic material, humus content and bacterial activity.

The effect of burying the root system and this vital layer of soil is to kill the tree. Some trees are more sensitive than others, and as little as six inches of additional material can cause an oak to die—not immediately but over a period of years. Clay is particularly injurious as it forms a heavy impervious layer, preventing the entry of water or air into the soil.

The only safe rule about altering site levels is to avoid doing so if it is at all possible. If it must be done, the use of retaining walls enclosing an area equal to that of the tree canopy overhead, together with additional drainage to prevent ponding, is the next best thing. If that is not acceptable, it may be possible to build up the soil gradually at the rate of one or two inches per year. Another method successfully used recently round an oak in Hyde Park was to form a retaining barrier 6 feet square and 3 feet deep filled with a chemically-inert clinker and turfed over.

Lowering the level round the base of the tree does not appear to upset it so much and natural examples can be found of Scots Pine growing on the edge of sandy embankments. As the sand has eroded, the exposed roots have taken on the characteristics of the trunk, even to the extent of its orange bark. Although the application is limited, provided the stability of the tree is not affected, soil can be removed carefully by hand from the base of the trunk; such excavation should be expertly supervised.

4. *Alteration of site surface material.* From what has already been said about the percolation of water and air into the soil, the importance of the top layer of soil and the maintenance of levels round existing trees, it follows that changing the surface material round a tree presents difficulties.

This situation occurs when a car park is planned in an area where there are a number of well grown trees. The construction of the tarmac or concrete surface will probably

mean excavation to at least 9 inches among the roots so that a well-compacted layer of hardcore can be laid, and if this is continued round the trees, they will almost certainly be killed.

Even if the trees survive, they are likely to have to endure a number of other changes. Although tarmac is not waterproof, its hard surface laid to falls will reduce the amount of water entering the soil. Furthermore, tarmac will prevent organic matter such as leaves passing into the earth, with a consequent reduction in fertility.

Although trees put up with an astonishing amount of ill-treatment from hard surfacing, the ideal is to keep an open area of grass, ground covers or loose gravel under the full extent of the tree canopy. This is seldom possible but the nearer the designer approaches to the ideal, the greater the chance of the trees surviving and flourishing.

5. *How near to excavate to trees.* There have been a number of generalisations made about the extent of root systems but the trees themselves seem to take little notice of them.

Where a tree is standing alone in a sheltered flat area, in a rich, deep and uniform soil, the chances are that it will develop a full plate of roots through 360° over an area about the size of the tree canopy above. Needless to say, this generalisation does not apply to fastigiate or weeping trees.

Such conditions are rarely met in nature. The tree is probably growing in company with others, or on sloping ground, or in an exposed position, with above-ground or underground obstructions, with soil varying in depth, texture or richness, or with a better food supply in one direction than another.

The root system as a result will be eccentric and unpredictable. The roots will grow strongest in the direction of a good food supply, will strengthen themselves against the prevailing wind, will often stop growing where they have met an obstruction or been cut off, are less likely to grow in the direction of other trees and, if on the edge of a wood, the strongest roots will be found growing outwards into the open.

If site layout requires placing a structure or road close to a tree, expert advice should be obtained at an early stage as to how close to the tree the roots can be cut off and how much of the root system can be removed. Swellings at the base of the trunk of a well developed tree sometimes indicate the direction of the root runs. Exploratory trenches can be dug—*by hand, not by machines*—to discover exactly where the roots are.

If roots of 1½ inches diameter and below are found, these can be severed, but if 2½ inches and above, trenches should be dug on the other sides of the trees to ensure that the root system is not eccentric, and severance of the roots will not cut the main feeders or the roots which give the tree its stability.

If tree roots have to be cut, they must be cleanly and smoothly cut, and the wound painted over with sealant.

There have been cases in the past where considerable thought was given to the siting of buildings and roads well clear of existing trees, but this forethought was cancelled out by taking drainage runs too close to the root systems. If the drains cannot be routed clear of trees, and it is in the interest of the drains themselves that they should be, they should be laid at depths below the root runs (4 feet and below). Digging must be done by hand and not by machine, and all roots above 1½ inches in diameter should be left—undamaged—bridging the trench until it is back-filled, when the trench materials should be carefully consolidated below and above the root.

6. *Felling of individual trees or groups.* As already mentioned there is a tendency for trees growing together to have eccentrically developed root systems. The result is that it is often impossible, particularly in the case of groups of two or three trees, to remove one tree without the others being blown over later.

The removed tree will open up the survivors to the force of the wind from the direction in which they were previously protected and in which their root system is weakest. The designer is then left with the hard decision of leaving the group alone or removing it in its entirety.

Provided the soil and the type of tree are suitable, there are occasions when the shortness of the root system in the centre of a group of trees can be exploited by placing the building close to the survivors. Such action also restores the protection the trees have had in the past.

7. *Wind flow and tall buildings.* The erection of large, tall buildings is bound to affect the existing wind flow patterns over a site. A series of slab blocks can create wind tunnels, funnelling wind forces on to trees that have previously been protected by others or which have grown up unprepared for such violence.

In the case of really tall blocks, the problems are greater and more serious. Wind forces are higher at the top of a building, and the higher the building, the higher the speed of the wind experienced at the top. To make matters worse, tall buildings cause down draughts, not only passing down the full force of the wind but increasing it at the sides at ground level by as much as 60 per cent.

These conditions will affect the growth of existing trees and they may be cut by the wind in the same way as exposed trees on the coast or in mountainous regions. Newly planted nursery stock will have great difficulty in becoming established.

8. *Fumes.* Trees can be affected by poisonous fumes and cases have occurred in Switzerland where the relatively mildly polluted air from the exhaust of an underground garage ventilation system has killed trees. It is true that the air in that country is unusually pure, and that trees in Great Britain are used to a more highly polluted atmosphere, but the designer is advised to position exhaust openings and vent pipes some distance away from growing material.

9. *Future growth.* When siting buildings in relation to existing trees, space should be allowed for future growth. Tree roots may accommodate themselves to restriction on one side, but restriction on all four sides will inhibit development.

A tree which has one or two hundred years of growth in front of it is likely to increase the spread of its tree canopy several times and may become a nuisance to the owner or occupier.

How much a tree will add to its height and spread depends on a large number of factors and it is worth while taking expert advice on the question.

We have so little sunshine in this country that the retention of a large tree on the south side of a residential development close to a building can only be temporary; sooner or later an occupier is going to ask for it to be removed, and if the tree is close and blocks out a high proportion of sunshine and daylight, the request will be hard to refuse.

D. SITE WORKS.

1. *Felling.* One of the first things the builder will do on the site is to fell trees which are not to be kept. During the operation trees can be damaged in two ways.

The first is short term and covers the operation of getting the trees down and away from the ones which are to remain. Careful marking and checking will ensure that the right ones are removed, and the employment of a competent firm of tree surgeons will reduce felling and extraction damage to a minimum.

The second is long term. Where trees are growing close together, some damage is bound to occur and boughs be broken and bark torn. The scars or wounds may appear superficial, but unless cleaned up immediately they will be infected by fungus or rot and, in twenty or thirty years' time, render the trees dangerous. Again, the employment of a competent firm of tree surgeons, together with instructions to clean up boughs, trunks and roots on completion, will remove this danger.

Where a firm of tree surgeons is not employed, and the trees are growing close together, careful supervision will be necessary to see that heavy machinery is not used in confined spaces among the trees. When this supervision is not possible, complete fencing off is an essential alternative.

To prevent their becoming breeding grounds for fungus and decay, it is good arboricultural practice to remove tree stumps and not leave them to rot away. With modern machinery, it is usually easier to grub the tree and its stump all in one operation.

2. *Burning.* When demolishing a building, the demolition contractor often burns all timber on the spot. On a well-treed site it may be difficult to find an area well away from trees. Unless this is done, branches will be burned but much more serious is the scorching of the bark of the trunk. Such damage may not be noticed until well into the next growing season when cracking appears; eventually the whole area of the scorched bark will fall away leaving the wood exposed to bird, insect, fungal and decay attacks. Because of its closeness to the ground, the base of the trunk will decay first, and decay at this level may affect the roots on the burnt side, finally rendering the tree unsafe.

   If the wound is cleaned up immediately and painted with sealant, there is a chance that it will callus over, but the painting will need regular inspections and further treatment until the callus has grown right over. Burned branches should be cleaned off flush with the trunk and the cut treated with the same sealant.

3. *Excavation.* Excavation to any depth may in itself affect the water table, particularly if dewatering equipment is used to prevent the hole from filling with water. Even if the hole is dry, the side of the excavation may dry out, desiccating parts of the root system. While something may be achieved by covering the side of the excavation with a sheet material to keep the moisture in, watering generously on the other side of the tree where the roots have not been disturbed will be more effective.

   Sometimes it has been found necessary to excavate closely to a tree on two sides, reducing the spread of the roots by half. This treatment is not to be recommended, but in a number of exceptional cases where the tree was either felled or a risk taken on its survival, the tree survived. However, with so much root removed, special precautions were taken to provide it with plenty of water, and to guy it in the direction from which the roots were removed.

   The final source of trouble in connection with excavation is disposal of spoil which must not be dumped on root systems or piled up against the trunks even temporarily. " Just for a day or two " soon turns into weeks and then into months. The most satisfactory method is to fence off all trees and to arrange special areas for spoil dumping.

4. *Soil Compaction.* Soil compaction is another problem connected with excavation and with the running of machinery from one place to another.

   Soil is a complex material, consisting basically of soil particles and four other constituents—organic matter, in varying stages of decay, from plants and animals; vast quantities of minute but living plants and animals; a solution of water and mineral salts and, finally, the soil atmosphere.

   The living organisms break down the organic material, and with the mineral solution and soil gases, provide the basic foods for plant growth.

   To do this effectively, the soil structure must be sufficiently open or cellular for water to be absorbed, gases stored and space be provided for the teeming millions of bacteria, worms and other forms of life to live, and roots from trees and plants to develop.

   The effect of even small machines passing over the top layers of soil is to destroy its structure, to crush out all forms of life, gases, watery solution and to tear the roots of plants. The end result is a hard, inert, impenetrable and infertile mass, and there is no quick and inexpensive method of reversing the process.

It is essential that machinery is kept away from the roots of trees and from all areas which are to be planted; if machines are confined to areas where roads, pavements, hardstandings and car parks are to be constructed, the compaction may be turned to advantage.

5. *Huts on the site.* Sometimes the range of huts on the site is extensive and the size of the temporary buildings can be very large.

   If they are placed underneath a tree, over the root system, they will prevent rain water penetrating into the soil and reaching the roots. If left long enough, the soil will dry out completely, lose its humus and texture, all forms of life will die out and the end product will be a dry dust. Roots growing in this material will also dry up and if the entire system is covered, the tree will die.

   All sheds and huts should be sited well away from trees, and specific instructions given to the builder at the beginning of the job.

6. *Storage of Materials and Topsoil.* Similar conditions arise from extensive storing of materials, with the added problem of compaction from delivery lorries and the weight of the materials themselves.

   With some materials, there are problems of chemical by-products seeping into the soil either as the result of rainwash or from the surplus left behind.

   There is only one safe rule—that no materials or topsoil are stored under the canopy of the trees and the most satisfactory method of ensuring this is to fence off the trees to the full extent of their canopies.

7. *Machinery.* Many types of machines are used in building operations and their use on the site brings a number of dangers. Compaction of the soil and crushing of roots have already been referred to, particularly from moving machines, but there are problems attached to stationary ones as well.

   These are often positioned " out of the way, under a tree," and the spilling or discarding of diesel fuel can be highly destructive. Concrete mixers require frequent emptying and cleaning, and the waste is often tipped out on to the ground, forming a hard, thick impervious layer.

   Once again, arrangements should be made with the contractor for their positioning where they will not do any damage.

8. *Use of Weed Killers.* During the course of constructional works, fenced off areas of the site may become infected with virulent weeds. Digging them out, even if possible from a cost angle, may damage the root systems of trees overhead and recourse should be had to weed killers. As a general rule total weed killers should not be put down but the non-residual types used.

E. GENERAL RECOMMENDATIONS

1. The Site Survey should be supplemented with Ecological and Tree Surveys.

2. The Design stage should take into consideration all the side effects of felling trees and placing a building on the site.

3. Before work begins, there should be close liaison between the people concerned and the main contractor, and a detailed drawing should be produced, showing all trees to be felled or retained, and clearly marking the positions and extent of protective fences, areas for storage of materials and permanent stationing of machines and huts, and the direction and width of temporary site roads.

4. If trees are growing close together, tree felling and extraction should be carried out by skilled specialist contractors. Any damage should be immediately treated.

5. Branches likely to interfere with the working of cranes or other machinery should be removed or tied back out of the way.

6. Parts of the site not to be used by the contractor should be fenced off with fences at least 4 feet high and stoutly constructed.

7. All trees inside the working areas should be protected with fences at least 4 feet high, enclosing a minimum area equal to the spread of tree canopy overhead (and greater in the case of fastigiate trees).

8. There should be frequent inspections (weekly in dry weather during periods of excavation) and arrangements should be made for additional watering when required.

9. Arrangements should be made for immediate tree surgery in the case of accidental damage, and for a final inspection and treatment, on completion.

AIM, OBJECTS AND FACILITIES OF THE ARBORICULTURAL ASSOCIATION

The objectives of the Association are : —

1. To advance the study of Arboriculture.
2. To raise the standards of its practise.
3. To foster interest in trees by publications, exhibitions, and the stimulation of research or experiment.
4. To assist in the training of students in the disciplines where Arboriculture is a major subject.
5. To co-operate with other bodies having aims similar to the above.

Activities held : —

Meetings arranged by regional branches, lectures and visits.

Publications issued by the Association : —

The Journal—published twice yearly.

The Newsletter—published three times during the year.

Advisory Booklets and Leaflets : —

No. 1. " Tree Preservation Orders "	10p
No. 2. " A Guide to Pruning "	15p
No. 3. " The Care of Trees on Development Sites "	50p
No. 4. " Trees—Site Preparation and Planting "	30p
No. 5. " A Tree for Every Site "	50p
No. 6. " Trees and the Law "	50p
" Tree Notes for Amenity Societies "	15p
" Trees for Small Gardens "	10p
" Arboricultural Officer "	5p
Wall Chart " Tree Care " for Schools	15p
"Rapid and Distant Recognition of Countryside Elms"	10p
Report of the Symposium on the Monetary Evaluation of Amenity Trees	50p
Journals (back numbers)	40p
Newsletters (back numbers)	30p

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P. AKERS, N.D.Arbor.,
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Northwood 21115.

Anyone interested in the work of the Arboricultural Association is invited to write to the Secretary for details—

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